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ABSTRACT

An automated system is a system that is used to reduce the need for human work in the production of goods and services. The biggest benefit of automation is that it saves labor. However, it is also used to save energy and materials and to improve quality, accuracy and precision. Automation system can be applied to the greenhouse irrigation system because of many reasons. With automation system everything can be done systematically, efficiently while saving a lot of cost factor such as money, energy and time. The use of microcontroller in the automation system has been broad nowadays because of its capability. Arduino is a one good microcontroller to use in the Greenhouse Autoduino because of the many good reasons it provides. On the other hand, Microcontroller is a highly integrated chip that contains all the components comprising a controller. Typically this includes a CPU, RAM, some form of ROM, I/O ports, and timers. Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task such as to control a particular system. As a result, the parts can be simplified and reduced, which cuts down on production costs as mentioned earlier.

ABSTRAK

Satu sistem automatik adalah sistem yang digunakan untuk mengurangkan keperluan untuk kerja-kerja manusia dalam pengeluaran barangan dan perkhidmatan. Manfaat terbesar automasi adalah bahawa ia menjimatkan buruh . Walau bagaimanapun , ia juga digunakan untuk menjimatkan tenaga dan bahan-bahan dan untuk meningkatkan kualiti , ketepatan dan ketepatan . Sistem automasi boleh digunakan untuk sistem pengairan rumah hijau kerana banyak sebab . Dengan sistem automasi semuanya boleh dilakukan secara sistematik , cekap sambil menjimatkan banyak faktor kos seperti wang , tenaga dan masa . Penggunaan pengawal mikro dalam sistem automasi yang telah meluas pada masa kini kerana ia keupayaan . Arduino adalah satu pengawal mikro yang baik untuk digunakan dalam Autoduino Rumah Hijau kerana sebab yang banyak baik ia menyediakan . Sebaliknya , pengawal mikro adalah sangat cip bersepadu yang mengandungi semua komponen yang terdiri daripada pengawal . Biasanya ini termasuk CPU , RAM , beberapa bentuk ROM , I / O port , dan pemasa . Tidak seperti komputer serba guna , yang juga termasuk semua komponen ini , pengawal mikro yang direka untuk tugas yang sangat khusus seperti untuk mengawal sistem tertentu . Akibatnya , bahagian-bahagian yang boleh dipermudahkan dan dikurangkan , yang dapat menjimatkan kos pengeluaran sebagai sebutan semula kes sebelum ini .

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CHAPTER 1

Introduction

1.1 Overview

Greenhouse Autoduino is an automated system where several sensors will be comprised in this project such as moisture sensor and also the temperature sensor to assist the Greenhouse Autoduino to operate automatically when in necessity instead of watering the plants manually. A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing [1]. Furthermore, the very main function of this project is the automated watering system that relies on the sensors that will be installing inside the greenhouse itself. This is essential to the plant inside the Greenhouse Autoduino because the weather in Malaysia is unpredictable and it demands some intelligent to be apply in watering cause of heating patterns in this country. Hence, the sensors will turn on the system only in need however the users of this system can manually activate functions in this greenhouse manually.

What are the uses of free time to complete a task that can be completed by using automated system? [2]. It's clearly indicates that automation are very important to daily routines because it can save energy, cost, and time. Automation on the greenhouse is not exceptional from this benefits, accident occur inside the greenhouse is unavoidable but it can be reduced with automated system because the labour force will decrease and on the other hand can reduces the probability of accidents occurring inside the greenhouse.

This automatic watering system is best to be applying inside the greenhouse because of certain circumstances and also act as quality control to the plants inside the greenhouse. Greenhouses work by using a transparent airtight cover to trap in light and moisture to create a mini- ecosystem that is separate from the environment around the greenhouse. An ecosystem includes all of the living things in a given area, interacting with each other, and also with their

non-living environments (weather, earth, sun, soil, climate, atmosphere) [3]. Because of that, automated watering system are being implemented in the greenhouse

1.2 Problem Statement

In the recent years, greenhouses are not automated watering system and using manual way to watering all the plants inside the greenhouse. Thus, the way to watering the plant is less effective and less systematic where the workers have to work hard in order to maintain the growth of the plants. The existing greenhouses are not automated where all of the information regarding the watering schedule needs to be documented manually into file or logbook. All of the records are crucial to ensure that all of the readings such as the temperature, watering rate and moisture are added into the log file that will produce by the system to facilitate the users of this system to track back previous actions.

Manual process of work will involves high cost in paying the workers to maintain the plants inside the greenhouse especially dry seasons in Malaysia. Almost all of the records of the readings need to be manual checked in order to keep the plants inside the greenhouse are in good condition in term of health and growth. something that has been done which was not intended by the actor, not desired by a set of rules or an external observer, or that led the task or system outside its acceptable limits[4]. Because of the reasons this system will created log file with necessary information to be included such as date and time. This is very systematic to prevent human errors.

1.3 Objective

The goal of this project is to develop an automated system for greenhouse. The following objectives are set:

- I.** To manage the greenhouse by applying the concept of automation system.
- II.** To maintain the quality of the plants.
- III.** To decrease human labour factor.

1.4 Scope

1. Arduino and sensors (moisture and temperature)

Arduino is a tool(microcontroller) for making computers that can sense and control more of the physical world than regular computer. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. With the help of Arduino, all of the reading inside the greenhouse will be take and being process for further action.

2. System User

The system target users is the person who in charge in greenhouse or the workers. This system can be access for initial setup for certain condition the automated will be running and the system can be manual operated by the workers.

3. Function

The function of this system is to help and assist the manual jobs by changing all of it into an automated system which the automated watering system. Every action and reading will be recorded into the database and can be view afterwards.

1.5 Methodology

Figure 1.1 shows the 6 stages of the Waterfall model design. Waterfalls are chosen because it is simple and easy to understand. The major advantage of the waterfall design is the developer can rollback to previous state to restructure the system. This methodology are best design for the Greenhouse Autoduino because Waterfall design can be good guidance for selecting appropriate methods, technique and tools base on the specific requirements for the project. The phases includes in this project are requirement gathering and analysis, system design, implementation, testing, deployment of system and maintenance.

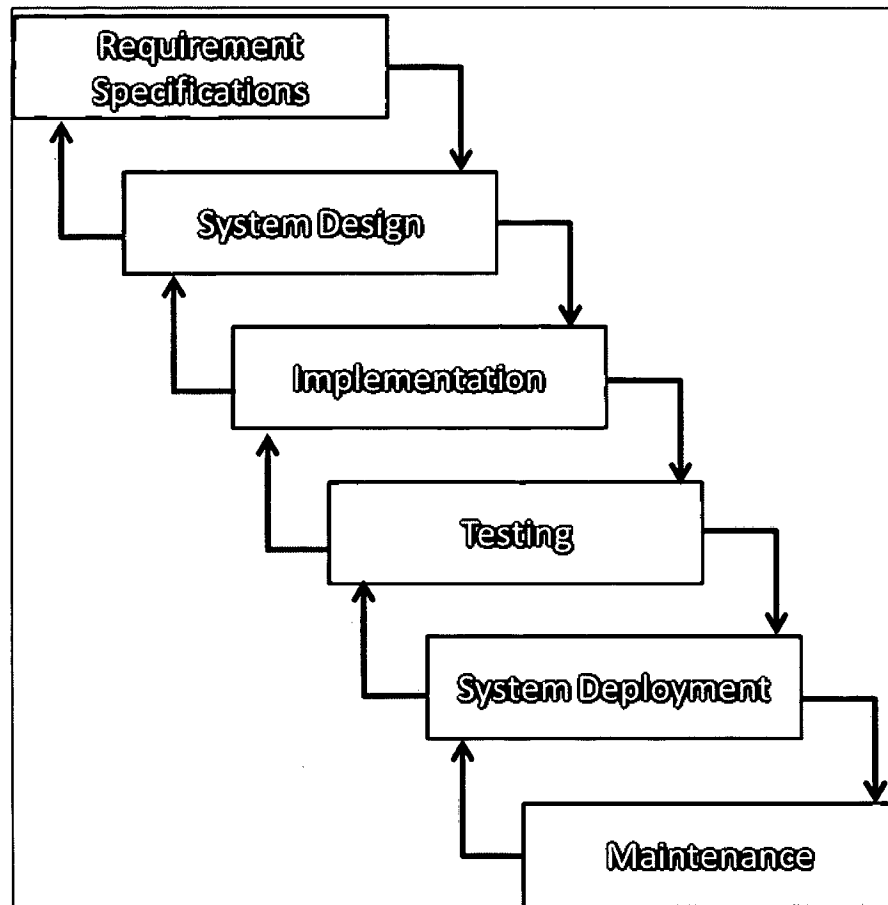


Figure 1.1 Waterfall Model Design

1.5.1 Requirements Specifications

All systems requirement analysis may need to be set out in this phase. It is a set of functional requirements and constraints that the end user expects from the system. Requirements are gathered from the end user, and analyzed for their validity and the possibility of combining them. Finally, a requirement specification document is created which serves the purpose of guideline for the next phase of the model.

1.5.2 System and Software Design

Before starting the actual coding phase, it is highly important to understand the requirements of the end user and also have an idea of how the end product should look like. The requirement specifications from the first phase are studied here, and a system design is prepared. The design helps in specifying hardware and system requirements, and also helps in defining the overall system architecture. The system design specifications serve as an input for the next phase of the model.

1.5.3 Implementation and Unit Testing

On receiving system design documents, the work is divided in modules/units and actual coding starts. The system is first elaborated into small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality; this is referred to as unit testing. Unit testing mainly verifies if the modules/units meet their specifications.

1.5.4 Integration and System Testing

The units are now integrated to form a complete system during the integration phase and tested to check if all modules/units coordinate with each other, and the system as a whole behaves as per the specifications. After successfully testing the software, it is delivered to the customer.

1.5.5 Installation and Deployment

The software is now applied by the customer to his/her own system(s). What the customer needs to take care of is his own system complying with the minimum system requirements of the software. He also needs to take care of any system configurations and reconfigurations on his side of the deal. Once the software is properly installed, he will begin communication with the dealers on a need-to-know basis, and help report any bugs that occur.

1.5.6 Operations & Maintenance

This phase of the model is virtually never-ending. Generally, problems with the system (which are not found during the development cycle) come up after its practical use starts, so the issues related to the system are solved after its deployment. Not all the problems come into picture directly, but they arise from time to time and need to be solved; hence this process is referred to as maintenance, even though it's still pretty much in the testing phase.

1.6 Thesis Organization

The research consists of five chapters:

Chapter 1 discussed the overview of the project. In chapter 1, the problem statements are introduced.

Chapter 2 critical analysis of the Greenhouse Autoduino methods and techniques is done in this chapter with reference to the previous work done across this area and introduction to electronic devices that will be used inside the greenhouse such as sensors.

Chapter 3 explains more about the methodology that will be used to carry out this research. It will be elaborated in detail about the step by step process that is being used to complete the project.

Chapter 4 detailed explanation to the design procedure followed by developing the framework and model through flow work. There will be explanation on how the model or hardware been implemented into selected algorithm.

Chapter 5 conclusion to the complete work done and the corresponding observations are made in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The objectives of this study are to introduce the arduino competency in controlling the irrigation system. Basically Greenhouse Autoduino and Home automation system has a lot of similarities in term of the way it operates. However, as the rapid growth of the technology increased the popularity of automation began in the market positively. Therefore, the study of a Greenhouse Autoduino system is being introduced to develop a system that will be affordable to almost everyone. Before proceed the architecture of Arduino and other devices, we need to review the current literature review on the related issues of home automation system. In this chapter, a literature review in support of the study will be carried out in the following 4 areas:

- 2.2 Overview of greenhouse autoduino
- 2.3 The benefits of greenhouse autoduino
- 2.4 The existing system(home automation)
- 2.5 The problems with the current systems
- 2.6 Comparison of technologies

The literature review covers only the most relevant aspects of home automation in order to introduce the new technology used for home automation system.

2.2 OVERVIEW OF GREENHOUSE AUTODUINO

2.2.1 GREENHOUSE AUTODUINO TERMINOLOGY

Greenhouse technology is the most efficient way to control the quality of the plant inside. It is because the irrigation technique that has been applied inside each of every greenhouse. The drawback of greenhouse in terms of technology is the high cost and custom installer requirements have restricted them to high end greenhouse. The multitude of technologies in this space has also been detrimental to the adaptation rate [5]. However, the rise of technology such as Arduino and Raspberry PI made the system can be developed with such a low cost. Autoduino is referring to the combination of Arduino and automated system that embedded inside this system. This system can operate via two selective mode which is Automode and Manual mode to irrigate the plants.

2.2.2 THE HISTORY OF AUTOMATION

Automation system is not new in the market. In fact, it has been here for many years. The home automation technology has been introduced to the world for the last 30 years. However, for us the Malaysian market is new to implement the automation system in the greenhouse and very expensive. But, if the system more affordable, more people will purchase the devices and gadgets. Despite interest in greenhouse automation, by the end of the 1990s there was not a widespread uptake with such systems still considered the domain of hobbyists or the rich. The lack of a single, simplified, protocol and high cost of entry has put off consumers [6].

2.3 BENEFITS OF GREENHOUSE AUTODUINO

With the combination of automation system and greenhouse, users can experience a life of convenience. Other than that, users have the ability to control the operation of the system with automode that has been developed with the simple tap of finger on favorite technological device such as smartphones and tablets. Not only to make sure that the irrigation is off but save electricity, this convenient system also can decide when will the process of irrigation will occur thanks to moisture sensors. Furthermore, resources such as water can be utilized because of this system.

2.4 EXISTING SYSTEM

The automation technique that has been use in greenhouse autoduino is enhanced system of home automation system. For comparison, home automation system will be used as guidance in order to improve the greenhouse autoduino system. Automation system plays an important role in the modern life where concerned of safety is one of the foremost thoughts right after comfort. Many of studies have been conducted to develop the products at once to promote the benefits of this home automation system. There are a two existing system of automation has been developed using various kind of technology:-

2.4.1 X10

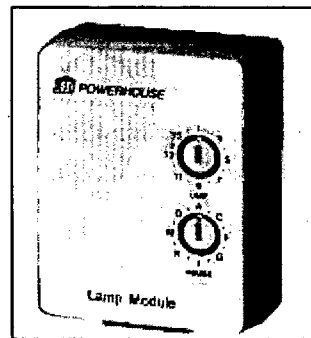


Figure 2.1: X10 Lamp Module

X10 is the standard used to control other X10 connected devices using the building's built in electrical system to transmit the signals [7]. Lights and devices can be plugged into X10 modules such as the ones sold by Habitek [8]. The modules are the interface between devices and the power lines which receive the commands from an X10 control devices. This can be basic device such as a remote control [9]. Delivering X10 command to the relevant X10 modules or a controller that is software based and runs on some sort of computer. An example of such software is X10 Controller [10]. It uses a graphical user interface to control X10 modules both locally on the computer and across the web. It runs as windows service which allows command to be issued when the computer is on, but the user isn't logged on [11].

2.4.1.1 X10 COMMANDS

The theory of transmitting commands to the X10 devices consists of transmitting byte codes along a power line. To connect devices to a computer we need to use a two-way interface called CM12U (this is the U.K 240v version of 110v CM11A which will see widely used in home automation in the US [12]) connect to the Computer and then to the power line. AC (alternating current) is the current that we have in our homes in the Malaysia. AC has a “current that changes polarity or direction, respectively, overtime [13]” This type of current forms a sine wave as shown in Figure 2. Commands are sent along the power lines and “transmissions are synchronized to the zero crossing point of the AC power line”.

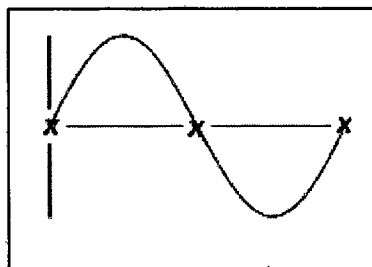


Figure 2.2: Sine Wave

The zero crossing points are when the sine curve crosses the x axes (as marked by the red crosses above). The transmitter provides a square sine wave [14]. “The rate of changing direction (from positive to negative) is called the frequency of the Alternating Current and is measured in hertz (Hz)” [15]. In the Malaysia our electricity is delivered to our homes with a frequency of 50Hz [16]. This means that one cycle/sine wave takes $1/50$ seconds, which is 20 milliseconds. X10 transmission is sent at the zero crossing point of the AC Sine Wave. The aim should be to transmit the data with a 200 microsecond threshold of the zero crossing point [17].

2.4.1.2 X10 DEVICE COMMANDS

X10 Device Commands consist of a bit “Start Code”, followed by a “House Code” (denoted by letters A-P but transmitted in Binary), then followed by either a “Device Code” (denoted by number 1 -16 but transmitted in Binary) or by a “Function Code”, then followed by a “Function” bit which is tagged on to the end of 9 the Device/Function code to let the X10 modules know whether it is an addressing command or a function command [18]

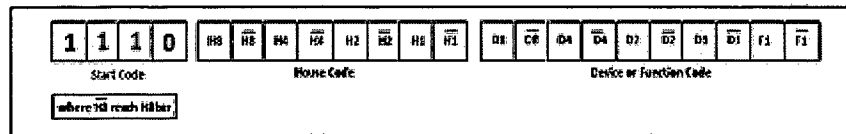


Figure 2.3: X10 Transmission Format

We first send a message consisting of the Start Code, House Code and Device Code. The next message we need to send consists of the Start Code, House Code and Function. Each message is sent in full twice, with at least three power line cycles between each message [19]. This does not apply with the dimming commands as then the message are sent continuously. For example if we want to transmit the verbal command “turn on Device 1, in House A” we would send the following: The house code for A is: 0110 The Device code for 1 is: 01100 The Function Code for on is: 00101

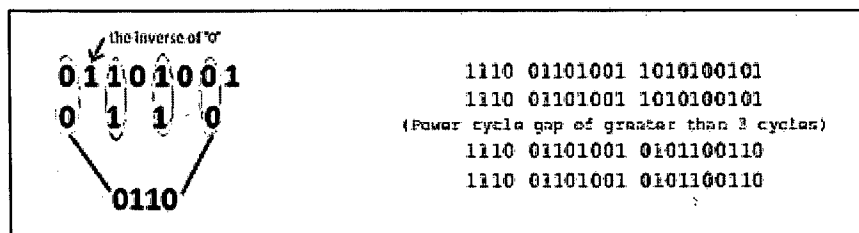


Figure 2.4: Decoding True bit and complement bit codes

2.4.2 INSTEON

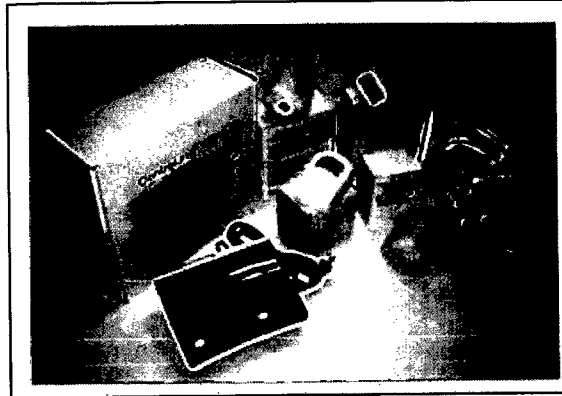


Figure 2.5: Insteon Home Automation modules

Insteon is brand name for another alternative to X10. Insteon uses modules between each device and the power line. Each module acts as both a transmitter and a receiver, so no dedicated transmitter modules are required. Insteon technology is that it is backwards compatible with X10. People who already own X10 devices can use them in their Insteon network without the need to replace them. Developers at Insteon have looked more deeply into devices and looking at how they can control air-conditioning and heating system relatively easily, taking the home automation arguably to the next step past X10. The reason they wanted to develop this product was that they thought that there were reliability issues with X10 and wanted to improve on the X10 technology.

2.4.2.1 HOW INSTEON SENDS COMMANDS

Insteon devices like X10 have to message methods, a standard and an extended message. The standard message length for Insteon is 10 byte.

| INSTEON Standard Message - 10 Bytes | | | | |
|--|-------------------|---------------|---------------------|------------------------|
| 3 Bytes | 3 Bytes | 1 Byte | 2 Bytes | 1 Byte |
| From Address | To Address | Flags | Command 1, 2 | CRC³ |

Table 2.1: Insteon Standard Message Structure

The Insteon messages are much larger than X10 message, they are as minimum 80bits (10 bytes) but 14 byte longer for extended messages. It does however mean that both the message and the command are stored together and sent together rather than in two separate messages as they are in X10.

2.5 PROBLEMS WITH THE CURRENT SYSTEM

The first clear disadvantages to some of the systems are cost. If money is not object then we can get some really great systems, but seeing as this is not the case for many people, budget is a key factor. If a product is to become successful it needs to be financial accessible to the mass market. X10 and Insteon system are not an option for a lot of people, therefore affordable plug and play and easily configurable solutions need developing, even if they do have slightly less functionality than the X10 and Insteon system. The problem with current home automation system is that the home automation standards are extremely fragmented. The problem with this is there is no universal standard, and lots of protocols and devices are proprietary and this makes it harder for new system to be developed as quickly as we would like.

2.6 COMPARISON OF TECHNOLOGIES

Insteon and X10 are both designed to achieve very similar goals. Insteon offers a broader scope for development in the future and its mesh network topology should make the system more reliable of the two. Insteon is not currently available for sale in the Malaysia yet. Insteon prices in the US are considerably more expensive, but as Insteon is not sale in the Malaysia, it is hard to make a direct comparison.

2.7 SUMMARY

Form my research I then concluded with the main technologies that I will use in my own systems. I will use Arduino UNO in my system as it is a relatively simple protocol that is ideal for developing an Greenhouse Autoduino System in the time scale I have. C language will be used as the main language for my system due to its multi-platform compatibility with Arduino UNO along with the Ethernet shield for the webserver purpose.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will discuss the methodology use to complete the project. 6 phase of Waterfall design will be involve in this project which are requirement specifications, system design, implementation, testing, system deployment and maintenance. The methodology that will be used is the Waterfall model design.

Essentially, it's a framework for software development in which development proceeds sequentially through a series of phases, starting with system requirements analysis and leading up to product release and maintenance .Waterfall model design has been selected because it is simple and easy to understand also easy to manage because of the flexibility of the model design. Furthermore, each and every phase inside Waterfall model design are processed and completed one at a time. In order to follow the guidance from Waterfall design project, clear vision of project plan must be identified because the Waterfall design in need of upfront and extensive planning. Moreover, Waterfall development processes tend te be more secure because it has plan oriented based.

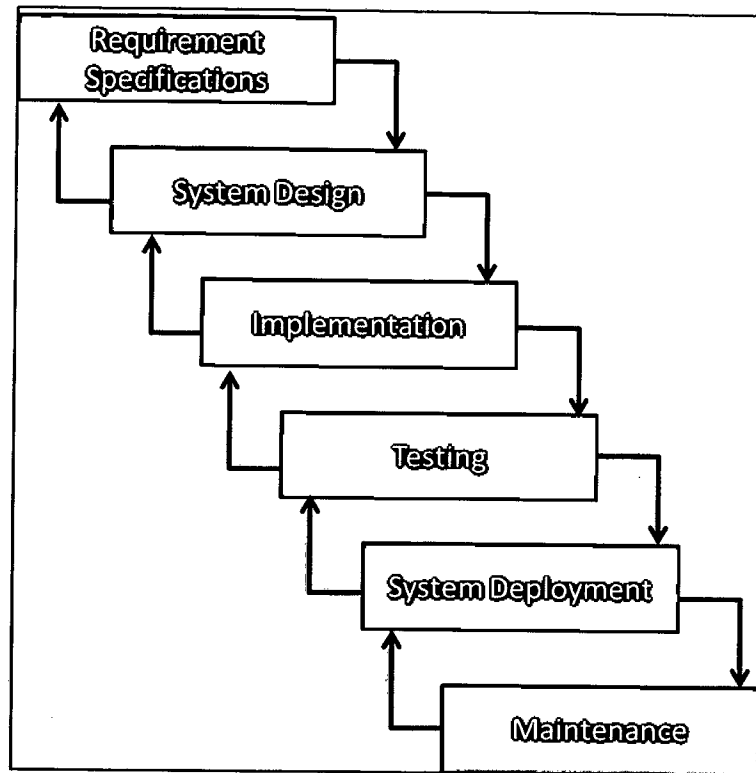


Figure 3.1 Waterfall Phases

Advantages of Waterfall model design

- Ease of use and easy to understand
- Manageability because of the design structure.
- Systematic phases
- Works well for small project
- Waterfall guarantees the systematic flow of system, through deployment and appropriate implementation and sufficient investigation.
- Waterfall process ensures early detection of faults and misinterpretation in its each stage.
- The waterfall model can aid resourceful knowledge transfer project are in progress.

3.2 Requirement Specifications

This first step is also the most important, because it involves gathering information about what are going to use inside the greenhouse, in the clearest possible terms, the problem that the greenhouse is expected to solve. Analysis includes understanding the greenhouse context and constraints, the functionality of the Arduino must perform the performance levels it must adhere to, and the external systems it must be compatible with. Techniques used to obtain this understanding include research on Arduino and the watering pattern of certain plant, use cases, and "shopping lists" of software/hardware features. The results of the analysis are typically captured in a formal requirements specification, which serves as input to the next step.

3.3 System Design

This step consists of defining the hardware and software architecture, components, modules, interfaces, and data in order to satisfy the requirement specifications. It involves defining the hardware and software architecture, specifying performance and security parameters, designing data storage containers such as MySQL and constraints, choosing the correct type of Arduino and programming language, and indicating strategies to deal with issues such as exception handling, resource management and interface connectivity. This is also the stage at which user interface design is addressed, including issues relating to navigation and accessibility. Bear in mind that, the Greenhouse Autoduino will be controlled by supported smartphones devices online. The output of this stage is one or more design specifications, which are used in the next stage of implementation. For better understanding, context diagram for user side and administration/programmers site has been created. The data flow diagram also has been created to show the movement of entities, process of the system and database system.